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Consciousness and Brain Rivalry

This paper will focus on the concept of consciousness and its relation with Brain Rivalry. Consciousness and ability to perceive with or without interacting with the world is one of the challenging researches which findings will lead to solving the mystery of the perception in people in vegetative state, whether it exists or not and if yes how it can be regained. In this commentary I will explain the consciousness with an example of a patient who spent the last 14 years of her life in vegetative state without doctors being able to tell if she was locked-in. Then I will discuss Brain Rivalry which can potentially help us understand the difference between conscious and unconscious state.

The term consciousness refers to the sense of selfhood and being able to cognitively experience or feel awareness about internal and external objects or happenings. Defining consciousness biologically and psychologically is not as hard as defining the boundary between conscious and unconscious in cases where damage is in the way of accessing the brain in patients in vegetative state.

Previous studies and analyses of synchronization between oscillations of activity in various brain loci has proven that brain-wide rhythm of neural activity associated with consciousness arises from interaction of theta and gamma frequency brain oscillations.[1] This was accomplished by collecting EEG data during an experiment in binocular rivalry. Although this revealed some aspects and indications of consciousness, there is not enough evidence to measure awareness in vegetative state brains. The case of Karen Ann Quinlan who went into permanent vegetative state for 14 years before her death has significance in terms of figuring out if she was conscious and was experiencing anything at all. Her fMRI revealed normal activity which raised the question that she might have been locked-in. Locked-in syndrome (LIS) is a condition in which a patient is aware but cannot move or communicate verbally due to complete paralysis of nearly all voluntary muscles in the body except for the eyes.[2]

During her life it was not possible to study her brain damage, but after her death from a respiratory failure her brain stem and spinal cord were examined. During her brain autopsy it was observed that her thalamus was undergone massive loss while her cortex suffered little loss. Her brain stem which controls breathing and cardiac functions was undamaged. These findings suggest that the thalamus plays a particularly important role in consciousness.[3]

Searching for an answer to Karen Ann's state of consciousness or generally distinguishing a conscious brain from an unconscious one we come across Binocular rivalry. Binocular rivalry is a type of perceptual rivalry. The concept put simple and clear is that when human's visual system is presented with two images at a time and to both eyes, he is only conscious of one of the images at a time. One of the images is dominant and the other one stays suppressed. This is interesting because if we can figure out what happens in brain when it switches from conscious

[1] Doesburg SM, Green JJ, McDonald JJ, Ward LM (2009) Rhythms of Consciousness: Binocular Rivalry Reveals Large-Scale Oscillatory Network Dynamics Mediating Visual Perception. PLoS ONE 4(7): e6142. doi:10.1371/journal.pone.0006142

[2] Bauer, G. and Gerstenbrand, F. and Rumpl, E. (1979). "Varieties of the locked-in syndrome". Journal of Neurology 221 (2): 77–91. doi:10.1007/BF00313105. PMID 92545.

[3] Kinney, H. C., Korein, J., Panigrahy, A., Dikkes, P. and Goode, R. (1994). Neuropathological Findings in the Brain of Karen Ann Quinlan – The Role of the Thalamus in the Persistent Vegetative State. The New England Journal of Medicine. 330:1469–1475.

to unconscious between the two images, we can use these findings to solve the mystery of cases such as Karen Ann's.

The brain generates the conscious experience and provides a neural correlate of consciousness but the question is how the competition between the images are resolved, and based on what factors one of them becomes dominant. In a broader view why does this switch even happen? There is no comprehensive answer for these questions and the researches are ongoing. For example one research found saliency makes a difference. An upright image is "stronger" compared to an upside down or a garbled face.[4] Deeper researches' revealed that ongoing perceptual awareness is associated with synchronized frontal-parietal gamma-band network and there are more augmented and synchronized network where perceptual awareness is experienced.[5] Also Gamma-band synchronization has been found to be linked to theta cycle, the rhythm of consciousness.

The above findings suggest that thalamus is the part in the brain that is responsible for consciousness. With more empirical evidence and further analysis finding the answer to the question "how the brain gives rise to the conscious mind[6]" looks promising.

[4] Engel, E. (1956) The role of content in binocular resolution. Am J Psychology 69: 87-9
[5] Ward, L.(2016) Neural Synchronization and Consciousness, UBC lectures
[6] Ward, L.(2011) The thalamic dynamic core theory of conscious experience, Consciousness and Cognition 20 464–486,ScienceDirect.com